International Journal of Research in Agronomy 2024; SP-7(10): 22-28

E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(10): 22-28
Received: 22-07-2024
Accepted: 28-08-2024

Rubaya Tabassum
Rayat Bahra University, Punjab, India

Sarita
Dolphin PG College Science and Agriculture, Chandigarh, India

Iqra Javaid
SKUAST, Kashmir, Jammu and Kashmir, India

Brajesh Kumar
Dolphin PG College Science and Agriculture, Chandigarh, India

Nidhi Sharma
Dolphin PG College Science and Agriculture, Chandigarh, India

Satypriy Sikarwar
Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

Harishankar
J.N.K.V.V. Jabalpur, Madhya Pradesh, India

Corresponding Author:
Rubaya Tabassum
Rayat Bahra University, Punjab, India

Effect of integrated nutrient management practices on nutrient content & nutrient uptake and productivity of wheat crop

Rubaya Tabassum, Sarita, Iqra Javaid, Brajesh Kumar, Nidhi Sharma, Satypriy Sikarwar and Harishankar

DOI: https://doi.org/10.33545/2618060X.2024.v7.i10Sa.1697

Abstract
The experiment was conduct in randomized block design with 8 treatments and three replications. T_1) Control, (T_2) 100% RDF,(T_3) 75% RDF + 6 t ha^{-1} FYM+ 2 kg ha^{-1}S, (T_4) 75% RDF + 2 t ha^{-1}Vermicompost + 2 kg ha^{-1}S, (T_5) 75% RDF + 4 t ha^{-1} FYM + 4 kg ha^{-1}S,(T_6) 100% RDF + 2 t ha^{-1}Vermicompost 8 kg ha^{-1}S, (T_7) 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S, (T_8) 100% RDF + 6 kg ha^{-1}S. The result revealed that plant height (109.00 cm), number of tillers $plant^{-1}$ (192.26), dry matter accumulation (1235.62 g m^{-2}), seed yield (5511.09 t ha^{-1}), straw yield (6717.56 t ha^{-1}) were obtained maximum in treatment 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S and the maximum gross return (Rs. 134992 ha^{-1}), net return (Rs. 68778 ha^{-1}) were obtained under 75% RDF + 4 t ha^{-1} FYM + 4 kg ha^{-1}S treatment. The result concluded that in this endeavour, proper balance of organic and inorganic fertilizer is important not only for increasing yield but also for sustaining soil health.

Keywords: NPK, vermicompost, wheat, grain and stover yield

Introduction
Wheat (*Triticum aestivum* L.) is the world's most widely cultivated food crop. Wheat grain contains about 12% protein which is more than that in other cereals and is of special significance to maintain the good bread making quality, due to the presence of a characteristic substance called 'gluten'. It has also a relatively high content of niacin and thiamine. Wheat is the second most important grain crop after rice in India. India has ever growing population, it has been projected that to feed 1.3 billion population and for diversified uses, India will have to produce at least 109 million tons of wheat by 2021 AD which might be only possible through elevating the national productivity up to 40.0 q ha^{-1} (Nagarajan and Rana, 2002) [15]. Wheat is the most widely cultivated crop which provides food and nutrition to two-third population of the world. India ranks second in wheat production in the world next to China. Wheat is the second staple food crop of India after rice and consumed by nearly 65 percent of the population (Mishra *et al*., 2005) [14] and ranks first in dietary shares of northern India (Joshi *et al*., 2007) [10]. India ranks second in wheat production in the world next to China. India has 30.22 M ha area under wheat cultivation with production of 93.50 Mt (Anonymous, 2020) [2]. In Punjab, area under wheat production is 3.46 M ha with production of 17.63 M T (Anonymous, 2021) [3].
Organic fertilizers may be processed in a factory, or, in the case of manure and compost, at a farm. Chemical fertilizers have been refined to extract nutrients and bind them in specific ratio with other chemical fillers. These products may be made from petroleum products, rocks or even organic sources. There are significant differences between organic and chemical fertilizers in terms of nutrient availability and the long-term effects on soil, plants, and the environment. Wheat is the most important staple food grain crop in Indian diet and main source of protein and calories for a large section of population. Zinc is also the basic element for obtaining high yield of wheat which is involved in the metabolic process in the plant, biosynthesis of the growth hormone and auxins. Deficiency of zinc causes great loss of yield in wheat and chlorosis of the older leaf. Farm yard manure is the decomposed mixture of animal dung and animal urine along

with litter and other material from fodder feed to the cattle. The well decomposed farmyard manure contains 0.5% nitrogen, 0.2% phosphorous and 0.5% potash (Krishnamurthi, 2016) [13]. Application of Farmyard manure increased water holding capacity of soil cation exchange capacity, soil aeration, seed germination and plant growth. The total nutrients contain by farmyard manure is not available immediately. About 30-35% of nitrogen, 60-70% phosphorous and 70-72% of potassium are available to the first crop. Vermicompost is sample and effective technique to reprocess of agriculture waste, city garbage and kitchen waste into nutrition's compost by earth worm action vermicomposting technology involves the bioconversion of organic waste into vermicasts, Verm wash utilizing earthworms. These earthworms feed on the waste and their gut act as the bioreactor where the vermicasts are produce. These vermicasts are also termed vermicomposting and are rich in NPK and micro-nutrients, the nutrient content in vermicompost very depending on the waste materials that are used for compost preparation. The common available nutrient in vermicompost is as follows nitrogen 0.5-1.5% phosphorous 0.1-0.30% potassium 0.15-0.56% etc., (Krishnamurthi, 2016) [13]. The combined use recommended dose of fertilizers (RDF) plays an important role in wheat production. Application of NPK in balanced share at proper time has great impact on wheat yield. Increase in cropping intensity and introduction of high yielding varieties have caused substantial deplete of N and crop storage positive response to added N in the soil (Ali *et al*., 2004) [1]. Nitrogen plays a vital role in growth processes as it is an integral part of chlorophyll, protein and nucleic acid (Jabbar *et al*., 2009) [8]. Phosphorus stimulates flourishing and seed formation. Its deficiency is directly related with 1000 grains weight (Iqbal and Chauhan, 2003) [7]. The increase in intensity of cropping and production of high yielding fertilizer responsive cultivars has resulted in a considerable deplete of soil K reserves and eventually limits efficiency of other nutrients. It is, thus, necessary to devise a fertilizer technology facilitating use of NPK in apt combination for enhancing wheat yield (Iqbal and Chauhan, 2003) [7]. Excessive use of chemical fertilizer in agriculture, resulting in a large number of environmental problems because some fertilizers contain heavy metals (e.g. cadmium and chromium) and high concentrations of radionuclides and some result in the accumulation of inorganic pollutants. Excess of fertilizer may cause problems like the amount of nitrate may increase in drinking water and rivers as the result of high levels of nitrogenous fertilizer use. The integrated use of either farm yard manure, compost or vermicompost with inorganic fertilizers may be highly effective for increasing the yield under late sown wheat as well as better quality of produce in addition to sustaining biological health and maintaining balanced C: N ratio of the soil. The INM refers "a system which aim to improving and maintaining soil fertility for sustaining crop productivity and involves the use of chemical fertilizers in conjunction with organic manure rich input through biological process". Incorporation of organic sources i.e. farm yard manure (FYM), improving physical properties and organic carbon status of the soil. The information on nutrient management under late sown wheat is very meager and fragmentary. On account of continuing world energy crisis and spiraling price of chemical fertilizer, the use of organic manure as a renewable source of plant nutrients is assuming importance. In this endeavor, proper balance of organic and inorganic fertilizer is important not only for increasing yield but also for sustaining soil health (Weber *et al.*, 2007) [22].

Material and Methods

The experiment was conducted during Rabi season 2022-23 at Agronomy Research Farm of Dolphin (PG) college of Science and Agriculture, Chunni Kalan; a campus of Punjabi University, Patiala, Punjab. Geographically, it is situated on the Fatehgarh Sahib Chandigarh road, Chunni Kalan it is located at 30^0 09 N latitude and 76^0 33 E longitude at an altitude of 281 meters above the mean sea level. The experiment was laid out in a randomized block design (RBD) with 3 replication. T_1) Control, (T_2) 100% RDF,(T_3) 75% RDF + 6 t ha^{-1} FYM+ 2 kg ha^{-1}S, (T_4) 75% RDF + 2 t ha^{-1}Vermicompost + 2 kg ha^{-1}S, (T_5) 75% RDF + 4 t ha^{-1} FYM + 4 kg ha^{-1}S,(T_6) 100% RDF + 2 t ha^{-1}Vermicompost 8 kg ha^{-1}S, (T_7) 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S, (T_8) 100% RDF + 6 kg ha^{-1}S. The experimental crop was uniformly fertilized with 150 kg N, 75 kg P_2O_5 and 60 kg K_2O ha^{-1} in the form of urea, diammonium phosphate, muriate of potash and vermin compost (@ 2 ton/ha), respectively as per treatment basis individually. Half dose of nitrogen was applied as basal. Clean and healthy seed of wheat cv. PBW 550 was shown at row to row distance of 22.5 cm at the rate of 100 kg ha^1. Yield and Yield Attributes

The observations on yield and yield attributes characteristics were recorded using standard methods. The random selection of ten spikes of wheat was done at harvesting stage and their length (cm) was measured in centimeter from the base of the spike/lower spikelet to the tip of the spikelet's and mean length of spike was computed. Number of spikelet's from the ten spikes selected and noted for each plot to compute the spikelet per spike and average was computed. From the ten selected spikes of wheat, grains were separated, cleaned and counted and the mean value of grains spike^{-1} was computed. After threshing and weighing, a random sample of grains was drawn from grain yield of each plot. From this sample, 1000 grains were counted at random and their weight (g) was recorded. After harvesting the crop, produce was sundried for one week and then weight of total produce which was harvested from net plot area of each plot recorded and converted into q ha^{-1}. After taking the weight of total biomass, produce of each net plot was threshed separated and clean grains were sundried to maintain 12% moisture. The grain yield was recorded in kg plot^{-1} and finally the values were converted into q ha^{-1}. Weight of total produce per net plot was recorded before threshing. The straw yield was calculated by subtracting the grain yield from the weight of total produce of net plot and expressed in q ha^{-1}.

Harvest index (%)

The harvest index of green gram was obtained by dividing the economical yield (grains yield) with the biological yield (grains + straw) and represented in percentage.

$$Harvest\ \ Index = \frac{Economic\ yield\,(q/ha)}{Bio\log ical\ \ yield\,(q/ha)}x100$$

Chemical analysis

Soil pH was determined in 1: 2.5 soil-water suspension by glass electrode pH meter method (Jackson, 1973) [9].

Organic carbon

The organic carbon content of a finely grand soil sample will be determined by Walkley and Black Method (Jackson, 1973) [9] and expressed in g kg^{-1} soil. Available nitrogen Available nitrogen will be estimated by alkaline $KMnO_4$ method where the organic matter in soil was oxidized with hot alkaline $KMnO_4$ solution. The ammonia evolved during oxidation was distilled and trapped in boric acid mixed indicator solution. The amount of NH_3 trapped was estimated by titrating with standard acid (Jackson, 1973) [9]. Available phosphorus

The available phosphorus content of soil was determined by the method described by Olsen *et al*. (1954) [16]. 2.5 gm of dried soil sample containing pinch of Darco G- 60 was extracted with 50 ml of 0.5 M $NaHCO_3$ (pH 8.5) for 30 minutes. Five ml of filtrate was taken in 25 ml volumetric flask; 2-3 drops of p- nitro phenol indicator added resulted yellow Colour was developed. After that 5N H_2SO_4 drop by drop were added until yellow colour disappear to acidify up to 5 pH. 4 ml of ascorbic acid solution was added to the flask and volume was made. The blue colour was obtained; the intensity of blue colour which is proportional to phosphate was read on the spectrophotometer at a wave length of 730 nm by using a red filter. The blank was also prepared by adding the entire chemical except soil. The concentration of available phosphorus in soil was expressed in kg ha^{-1}.

Available phosphorus (kg ha^{-1}) = ppm of P calculated from standard curve × dilution factor × 2.24.

Available potassium

The available potassium content of soil was determined by the method described Five gm of processed soil was taken in a 150 ml conical flask and extracted with 25 ml of neutral normal ammonium acetate solution. The filtrate was aspirated in to the atomizer of the calibrated flame photometer and reading was noted. The concentration of available potassium in soil was expressed as kg ha^{-1} and calculated as:

Available potassium (kg ha^{-1}) = ppm K× dilution factor × 2.24.

Chemical plant analysis

Analysis of grain and straw samples of wheat crop was carried out for their nitrogen, phosphorus and potassium contents. Sun dried samples were oven-dried at 70 ± 2 °C and ground in Wiley Mill. 0.2 And 0.5 g of grain and straw respectively, were digested in di acid mixture of HNO_3 and $HClO_4$ (4:1). After digestion, a known volume was made with distilled water and stored in well washed plastic bottles after filtration through what man filter paper no. 42. All the estimations in the aliquot were made according to the following procedures: Nitrogen content Nitrogen content in grain and straw of wheat plant was determined by Micro-Kjeldahl method. Phosphorus content Phosphorus content in grain and straw of wheat and weeds plant was determined by vanadomalayaite reagent, yellow colour method. Potassium content Potassium in grain and straw of wheat and weeds plants was determined by flame photometric method (Jackson, 1973) [9]. Protein content in grains Protein content in grains of wheat at maturity was worked out by multiplying the nitrogen percentage of grains with 6.25. Nutrient uptake studies after estimating the content of nitrogen, phosphorus and potassium in grain and straw, uptake of these nutrients was calculated as kg ha^{-1} by multiplying the contents with grain and straw yields in different treatments as:

Nutrient uptake (kg ha^{-1}) = Nutrient content (%) X Yield (grain and straw q ha^{-1}) Nutrient Use Efficiency (NUE)

The following expressions were used for determining NUE as described by (Bandyopadhyay and Sarkar).Agronomic efficiency Agronomic efficiency (kg grain yield increase/kg nutrient applied) was calculated as follows:

$$AE = \frac{Yn - Yo}{N}$$

Where,
Yn = crop yield (kg/ha) in fertilized plot
Yo = crop yield (kg/ha) in control plot
N = nutrient applied (kg/ha)

Recovery efficiency

Recovery efficiency (%) was calculated as follows:

$$RE = \frac{Un - Uo}{N} x100$$

Where,
Un = total nutrient uptake in (kg/ha) in fertilized plot
Uo = total nutrient uptake (kg/ha) in control plot
N = nutrient applied (kg/ha)

The experimental data obtained during the course of study were subjected to statistical analysis using analysis of variance technique (ANOVA) for split plot design as prescribed by Gomez & Gomez, (1984) [5].

Result and Discussion

Data on various yield attributing characters *viz*; number of grains $spike^{-1}$, spike length, test weight as influenced by different treatments were recorded presented in Table 1. Number of grain $spike^{-1}$ Effect of different treatments on number of grain $spike^{-1}$ is shown in Table 1. From the table it is clear that the number of grain $spike^{-1}$ under different treatment ranged from 53.14 to 84.88. The maximum number of grain $spike^{-1}$ 84.88 found in case of the application of (T_7) 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S was significantly higher than the remaining treatments. The minimum number of grain $spike^{-1}$ 53.14 was recorded found from the control plot. Spike length Effect of different treatments on spike length is shown in Table 1. From the table it is clear that the spike length under different treatment ranged from 6.24 to 9.97. The maximum number of spikelet's $spike^{-1}$ 9.97 found in case of the application of (T_7) 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S was significantly higher than the remaining treatments. The minimum number of grain $spike^{-1}$ 6.24 was recorded found from the control plot. Test weight (g) Data presented in Table1indicated that the different integrated nutrient management showed non–significant effect on 1000-grain weight (g). Being non-significant, highest (44.72 g) and lowest (41.23 g) weight of 1000-grain was obtained with T_7 (100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S) and T_1 (Control), respectively.

Table 1: Effect of INM on number of grains per spike, spike length and test weight & grain yield, straw yield (kg ha^{-1}) and harvest index (%) of wheat crop

Treatments	Number of grains per spike	Spike length (cm)	Test weight (g)	Yield (kg ha^{-1})		Harvest index (%)
				Grain	Straw	
T_1: Control Plot	53.14	6.24	41.23	3450.00	4171.93	39.1
T_2: 100% RDF	76.88	9.03	43.76	4791.52	5850.91	42.4
T_3: 75% RDF + 6 t ha^{-1} FYM+ 2 kg ha^{-1}S	70.19	8.24	42.66	4557.09	5554.72	41.2
T_4: 75% RDF + 2 t ha^{-1}Vermicompost + 2 kg ha^{-1}S	70.92	8.33	43.18	4804.74	5912.80	42.8
T_5: 75% RDF + 4 t ha^{-1} FYM + 4 kg ha^{-1}S	71.93	8.44	43.89	4869.84	5992.15	42.9
T_6: 100% RDF + 2 t ha^{-1}Vermicompost 8 kg ha^{-1}S	84.33	9.90	44.66	5475.20	6673.82	43.3
T_7: 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S	84.88	9.97	44.72	5511.09	6717.56	43.4
T_8: 100% RDF + 6 kg ha^{-1}S	78.25	9.19	44.36	5080.27	6192.43	42.6
SEm(±)	1.81	0.21	1.32	117.58	138.94	0.07
C.D. (P=0.05)	5.38	0.63	3.94	349.35	412.82	NS

Grain yield (kg ha^{-1}) it is clear from the results obtained (Table 6 and Fig. 7) from the investigation that there was a significant response in seed yield due to different treatments as compared to control. Seed yield varied from (3450 - 5511.09 kg ha^{-1}) under different treatments and the magnitude of increase in yield due to various treatments was 23.90 -59.74% over control. The maximum grain yield 5511.09 kg ha^{-1} recorded with the application was (T_7) 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S was significantly higher than the remaining treatments. The minimum yield of wheat 3450 kg ha^{-1} was recorded from the treatment under control T_1. It was also obtained that treatment (T_5) 75% RDF + 4 t ha^{-1} FYM + 4 kg ha^{-1}S was at par with treatment (T_4) 75% RDF + 2 t ha^{-1}Vermicompost + 2 kg and (T_2) 100% RDF. Straw yield (kg ha^{-1}) It is clearly evident from (Table 4.2 and Fig. 4.1), that straw yield was significantly affected by various treatments. Stover yield varied from (4171.93 - 6717.56 kg ha^{-1}) and the increase in straw yield was observed to the tune of 19.93 – 37.89% over control. The maximum straw yield 6717.56 kg ha^{-1} recorded with the application (T_7) 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S. The minimum yield of wheat 4171.93 kg ha^{-1} was recorded from the treatment under control (T_1). Harvest Index (%) From the Table 4.2, it can be drawn that application of different treatment of integrated nutrient management had no significant influence on the harvest index. However, being non-significant the highest harvest index value of 43.4% was recorded with T_7 (100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S), while the lowest value (39.1%) of harvest index was recorded with T_1 (Control Plot). These finding are supported by the results of Singh *et al*. (2008) [21], Shahi *et al.* (2016) [20] & Rathore and Sharma, 2009 [18], Kakraliya *et al*. (2017) [11] and Saleem *et al.* (2015) [19].

Nitrogen content in grain

Nitrogen content of wheat at different day's interval as affected by different treatments is presented Table 4.6. It is clear from the table that the nitrogen content of plant sample decreases with the advancement of plant growth. Nitrogen content in grain varied from 1.03 to 1.65 percent under different treatments. Nitrogen content in grain was affected significantly by different treatments. The highest nitrogen content in grain 1.65% recorded in T_7 with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S significantly higher than the remaining treatments. Nitrogen content in grain under control T_1 1.03% was found significantly lower than the rest to the treatments.

Phosphorus content in grain

Phosphorus content in grain at different day's interval as affected by different treatments is presented Table 4.6. Phosphorus content in grain varied from 0.18 to 0.31percent under different treatments. Phosphorus content in grain was affected significantly by different treatments. The highest phosphorus content in grain 0.31 percent recorded in T_7 with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S significantly higher than the remaining treatments. Phosphorus content in grain under control was found significantly lower than the rest to the treatments. Potassium content in grain Potassium content of wheat at different day's interval as affected by different treatments is presented Table 4.6. Potassium content in grain varied from 0.37 to 0.60 percent under different treatments. Potassium content in grain was affected significantly by different treatments. The highest potassium content in grain 0.60 percent recorded in T_7 with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S significantly higher than the remaining treatments. Potassium content in grain under control was found significantly lower than the rest to the treatments.

Table 2: Effect of integrated nutrient management on NPK content and uptake of wheat grain and straw

Treatments	Nutrient content in grain (%)			Nutrient uptake by grain (kg ha^{-1})			Nutrient content in straw (%)			Nutrient Uptake in straw (%)		
	N	P	K	N	P	K	N	P	K	N	P	K
T_1: Control Plot	1.03	0.18	0.37	35.80	6.09	12.95	0.35	0.07	0.88	14.73	2.97	36.82
T_2: 100% RDF	1.49	0.25	0.54	74.90	12.75	27.09	0.51	0.10	1.27	30.01	6.06	75.02
T_3: 75% RDF + 6 t ha^{-1} FYM+ 2 kg ha^{-1}S	1.36	0.23	0.49	62.44	10.63	22.58	0.46	0.09	1.16	25.91	5.23	64.77
T_4: 75% RDF + 2 t ha^{-1}Vermicompost + 2 kg ha^{-1}S	1.38	0.26	0.50	63.70	11.82	23.04	0.47	0.10	1.17	27.76	6.16	69.40
T_5: 75% RDF + 4 t ha^{-1} FYM + 4 kg ha^{-1}S	1.40	0.27	0.51	65.67	12.48	23.75	0.48	0.11	1.19	28.43	6.45	71.08
T_6: 100% RDF + 2 t ha^{-1}Vermicompost 8 kg ha^{-1}S	1.61	0.28	0.57	90.04	16.51	32.57	0.56	0.12	1.39	37.36	8.13	93.41
T_7: 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S	1.65	0.31	0.60	91.19	17.23	32.98	0.56	0.13	1.40	37.84	8.48	94.60
T_8: 100% RDF + 6 kg ha^{-1}S	1.54	0.29	0.55	78.35	14.74	28.06	0.52	0.12	1.29	32.51	7.26	80.48
SEm(±)	0.03	0.01	0.01	3.31	0.45	1.21	0.01	0.00	0.03	1.24	0.21	3.14
C.D. (P=0.05)	0.10	0.02	0.04	9.82	1.33	3.59	0.03	0.01	0.09	3.69	0.64	9.32

Nitrogen uptake by grain

Nitrogen uptake by grain at different day's interval as affected by different treatments is presented Table 7 & Fig 5. Nitrogen uptake by grain varied from 35.80 to 91.19 kg ha^{-1} under different treatments. Nitrogen uptake by grain was affected significantly by different treatments. The highest nitrogen uptake by grain 91.19 kg ha^{-1} recorded in T_7 with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S significantly higher than the remaining treatments. Nitrogen uptake by grain under control T_1 (Control Plot (0% NPK) was found significantly lower than the rest to the treatments. Phosphorus uptake by grain Phosphorus uptake by grain at different day's interval as affected by different treatments is presented Table 7 & Fig 5. Phosphorus uptake by grain varied from 6.09 to 17.23 kg ha^{-1} under different treatments. Phosphorus uptake by grain was affected significantly by different treatments. The highest Phosphorus uptake by grain 17.23 kg ha^{-1} recorded in T_7 with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S was significantly higher than the remaining treatments. Phosphorus uptake by grain under control T_1 6.09 kg ha^{-1} was found significantly lower than the rest to the treatments. Potassium uptake by grain.

Potassium uptake by grain at different day's interval as affected by different treatments is presented Table 7 & Fig 5. Potassium uptake by grain varied from 12.95 to 32.98 kg ha^{-1} under different treatments. Potassium uptake by grain was affected significantly by different treatments. The highest potassium uptake by grain 32.98 kg ha^{-1} recorded in T_7 with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S significantly higher than the remaining treatments. Potassium uptake by grain under control (12.95 kg ha^{-1}) was found significantly lower than the rest to the treatments. Nitrogen content in straw Nitrogen content in straw at different day's interval as affected by different treatments is presented Table 8. It is clear from the table that the nitrogen content of plant sample decreases with the advancement of plant growth. Nitrogen content in straw varied from 0.35 to 0.56 percent under different treatments. Nitrogen content in straw was affected significantly by different treatments. The highest nitrogen content in straw 0.56 percent recorded in T_7 with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S significantly higher than the remaining treatments. Nitrogen content in straw under control (0.56 percent) was found significantly lower than the rest to the treatments. Phosphorus content in straw Phosphorus content in straw at different day's interval as affected by different treatments is presented Table 4.8. Phosphorus content in straw varied from 0.07 to 0.13 percent under different treatments. Phosphorus content in straw was affected significantly by different treatments. The highest phosphorus content in straw 0.13 percent recorded in T_7 with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S significantly higher than the remaining treatments. Phosphorus content in straw under control was found significantly lower than the rest to the treatments. Potassium content in straw Potassium content of wheat at different day's interval as affected by different treatments is presented Table 4.8. Potassium content in straw varied from 0.88 to1.40 percent under different treatments. Potassium content in straw was affected significantly by different treatments. The highest potassium content in straw 1.40 percent recorded in T_7 with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S significantly higher than the remaining treatments. Potassium content in straw under control was found significantly lower than the rest to the treatments. Nitrogen uptake by straw Nitrogen uptake by straw at different day's interval as affected by different treatments is presented Table 4.9 & Fig 4.6. Nitrogen uptake by straw varied from 14.73 to 37.84 kg ha^{-1} under different treatments. Nitrogen uptake by straw was affected significantly by different treatments. The highest nitrogen uptake by straw 37.84 kg ha^{-1} recorded in T_7 with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S significantly higher than the remaining treatments. Nitrogen uptake by straw under control T_1 (Control Plot (0% NPK) was found significantly lower than the rest to the treatments.

Phosphorus uptake by straw Phosphorus uptake by straw at different day's interval as affected by different treatments is presented Table 9 & Fig 6. Phosphorus uptake by straw varied from 2.97 to 8.48 kg ha^{-1} under different treatments. Phosphorus uptake by straw was affected significantly by different treatments. The highest Phosphorus uptake by straw 8.48 kg ha^{-1} recorded in T_7 with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S significantly higher than the remaining treatments. Phosphorus uptake by straw under control (2.97kg ha^{-1}) was found significantly lower than the rest to the treatments. Potassium uptake by straw. Potassium uptake by grain at different day's interval as affected by different treatments is presented Table 4.9 & Fig 4.6. Potassium uptake by straw varied from 36.82 to 94.60 kg ha^{-1} under different treatments. Potassium uptake by straw was affected significantly by different treatments. The highest Potassium uptake by straw 94.05 kg ha^{-1} recorded in T_7 with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S statistically at par withT_6 (100% RDF + 2 t ha^{-1}Vermicompost 8 kg ha^{-1}S) and significantly higher than the remaining treatments Potassium uptake by straw under control (36.82 kg ha^{-1}) was found significantly lower than the rest to the treatments. These finding are supported by the results of Kathuria *et al.* (2004) [12], Gupta and Sharma (2006) [6], Pandey *et al.* (2009) [17].

Summary Conclusion

The present investigation entitled "Effect of Integrated Nutrient Management (INM) on Yield and Economics of Wheat (*Triticum aestivum* L.)" was carried out during *Rabi* season 2022-23 at Agronomy Research Farm of Dolphin (PG) College of Science and Agriculture, Chunni Kalan; a campus of Punjabi University, Patiala, Punjab. To assess the effect of weed management treatments on weed growth, crop growth, yield attributes, yield, nutrient uptake and economics of wheat. Experiment was laid out in a randomized block design with three replications. Maximum number of grains per spike, spike length (cm) and test weight (g) was found significantly higher in T_7 which was statistically at par T_6 while, minimum was found in T_1 control. Grain yield of wheat was affected significantly by different treatments. The maximum grain and straw yield 5511.09 kg ha^{-1} and 6717.56 kg ha^{-1} recorded with the application was 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S was found statistically at par with treatment $T_{6,}$ respectively. Harvest index did not influenced significantly by the application of nutrient management treatments. It was observed maximum in 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S) and lowest harvest index was recorded in control plots.

The highest NPK content in grain and straw were recorded in T_9 treatment with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S statistically at par with 100% RDF + 2 t ha^{-1}Vermicompost 8 kg ha^{-1}S vermicompost and significantly higher than the remaining treatments. NPK content in grain under control was found significantly lower than the rest to the treatments. NPK uptake by grain and straw at different day's interval was significantly affected by different treatments. Highest uptake in grain and straw were found in T_7 which was found statistically at par in T_6 while, lowest recorded was found control during both the years. The maximum seed and straw yield (5511.09 kg ha^{-1} and 6717.56 kg ha^{-1}, respectively) was obtained under treatment (T_7) 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S, which was at par with (T_6) 100% RDF + 2 t ha^{-1}Vermicompost 8 kg ha^{-1}S. However test weight, harvest index was not influenced by nutrient management practices. Similar results were found in yield attributes characters of wheat. The maximum available N (269.37 kg ha^{-1}) was obtained in the treatment having application of 100% RDF + 4 t ha^{-1} FYM (T_9) which was at par with the INM treatment received 100% RDF + 2 t ha^{-1}Vermicompost 8 kg ha^{-1}S ^{1}Vermicompost (T_6). The maximum available phosphorus and potash (16.98 and 318.47 kg ha^{-1}, respectively) was obtained in the treatment having application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S (T_7) but not significantly increased as compared to other treatments. The highest NPK content and their uptake of grain and straw were recorded in T_9 treatment with the application of 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S statistically at par with 100% RDF + 2 t ha^{-1}Vermicompost 8 kg ha^{-1}S and significantly higher than the remaining treatments. NPK content and their uptake of grain and straw under control was found significantly lower than the rest to the treatments. Gross return, Net return and B: C ratio (134991.94 Rs. ha^{-1}, 68778.19 Rs. ha^{-1} and 2.54, respectively) was recorded maximum (T_7) 100% RDF + 4 t ha^{-1} FYM 10 kg ha^{-1}S in treatment.

References

1. Ali H, Randhawa SA, Yousaf M. Quantitative and qualitative traits of sunflower (*Helianthus annuus* L.) as influenced by planting dates and nitrogen application. Int J Agric Biol. 2004;6:410-412.
2. Anonymous. Statistical Year Book India. Ministry of Statistics and Programme Implementation, Government of India; c2020.
3. Anonymous. Statistical Year Book India. Ministry of Statistics and Programme Implementation, Government of India; c2021.
4. Choudhary RR, Yadav HL, Choudhary SL, Prajapat AL, Choudhary R. Effect of integrated nutrient management on growth of wheat (*Triticum aestivum* L.) cultivars. Int J Curr Microbiol Appl Sci. 2003;6(8):2369-2374.
5. Gomez A, Gomez A. Statistical procedures for agricultural research. 2nd ed. New York: John Wiley and Sons; c1984.
6. Gupta V, Sharma RS, Vishwakarma SH. Long-term effect of integrated nutrient management on sustainability and soil fertility of rice (Oryza sativa) - wheat (*Triticum aestivum*) cropping system. Indian J Agronomy. 2006;51(3):160-164.
7. Iqbal M, Chauhan HQI. Relationship between different growth and yield parameters in maize under varying levels of phosphorus. J Biol Sci. 2003;3(10):921-925.
8. Jabbar A, Aziz T, Bhatti IH, Virk ZA, Wasl-u-Din. Effect of potassium application on yield and protein contents of late-sown wheat (*Triticum aestivum* L.) under field conditions. Soil Environ. 2009;28(2):193-196.
9. Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India Pvt. Ltd.; 1973.
10. Joshi AK, Mishra B, Chatrath R, Ortiz FG, Singh RP. Wheat improvement in India: Present status, emerging challenges and future prospects. Euphytica. 2007;157:431-446.
11. Kakraliya SK, Kumar N, Dahiya S, Kumar S, Yadav DD, Singh M. Effect of integrated nutrient management on growth dynamics and productivity trend of wheat (*Triticum aestivum* L.) under irrigated cropping system. J Plant Dev Sci. 2017;9(1):11-15.
12. Kathuria MK, Singh H, Singh KP, Kadian VS. Effect of INM on N and P content and uptake by wheat under cereals fodder wheat cropping system. Res Crop. 2004;5(1):31-35.
13. Krishnamurthi KK. Organic agriculture for sustainability. Organic fertilization technology. 1st ed. Chennai: Notion Press; c2016.
14. Mishra B, Shorean J, Chatrath R, Sharma AK, Gupta RK, Sharma RK, Singh R, Rane J, Kumar A. Cost effective and sustainable wheat production technology. Karnal: Directorate of Wheat Research; c2005. Technical Bulletin 8:1-2.
15. Nagarajan S, Rane J. Physiological traits associated with yield performance of spring wheat (*Triticum aestivum* L.) under late-sown conditions. Indian J Agric. Sci. 2002;72(3):135-140.
16. Olsen SR, Cole CA, Watanabe FS, Dean LA. Estimation of available phosphorus in soil by extraction with sodium

bicarbonate. Circular. U.S. Department of Agriculture; c1954. p. 939.
17. Pandey IB, Dwivedi DK, Pandey RK. Integrated nutrient management for sustaining wheat (*Triticum aestivum*) production under late sown conditions. Indian J Agronomy. 2009;54(3):306-309.
18. Rathor SA, Sharma NL. Effect of integrated nutrient management on yield and economics of wheat (*Triticum aestivum*). Asian J Soil Sci. 2009;4(1):15-17.
19. Saleem I, Javid S, Ehsan S, Niaz A, Bibi F, Ahmed ZA. Improvement of wheat grain zinc and zinc daily intake by biofortification with zinc. Int J Plant Soil Sci. 2015;8(5):1-6.
20. Shahi UP, Deshraj, Dwivedi A, Dhyani BP, Kumar A, Kishore R. Yield maximization of late sown wheat through INM approach and its consequence on physico-chemical properties of soil. Green Farming, 2016, 7(3).
21. Singh P, Singh P, Singh KN, Singh R, Aga FA, Bahar F, Raja W. Evaluation of wheat (*Triticum aestivum*) genotype for productivity and economics under graded levels of nitrogen in temperate Kashmir. Indian J Agric Sci. 2008;80(5):380-384.
22. Weber J, Karczewska A, Drozd J, Licznar M, Licznar S, Jamroz E. Agricultural and ecological aspects of a sandy soil as affected by the application of municipal solid waste composts. Soil Biol Biochem. 2007;39:1294-1306.